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Effects of stockperson attitudes and handling on finishing pig behaviour and mental state

Effekten av djurskötarens attityder och hantering på slaktgrisars beteende och känslotillstånd

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Abstract

This study is part of an ongoing project*, PigTraWel* (2019) which aims to investigate interactions between animal transporters and slaughter pigs during loading and unloading by mapping different driving methods, their effects on pigs and transporters and the efficiency of the work. Pigs are exposed to a number of environmental stressors prior to slaughter that can affect pig behaviour and welfare, the working situation of stockpeople involved and cause meat quality problems. Previous studies propose that the nature of the on-farm interactions between stockpersons and pigs may have an influence on pigs behavioural response during pre-slaughter treatments. Negative human-animal interactions on-farm are related with a high fear response in pigs, while positive human-animal interactions have been found to reduce animals fear response, increase ease of handling, and thus have benefits for both health and production. Pigs are able to generalize aversive or rewarding treatment by one stockperson and associate the treatment with the presence of humans. The aim of this study was to examine stockpersons working routines during handling of pigs in Swedish commercial pig farms and how specific stockperson handling affect pig behaviour. The study also aimed to examine stockpersons normative attitudes towards pig and pig caretaking in relation to pigs behavioural response. Previous research has found that there is a relationship between stockperson attitude and behaviour and pigs behavioural response. On-farm recordings were carried out at nine commercial pig farms at different locations in Sweden and data were collected by four different methods: a stockperson questionnaire of beliefs and perceptions, observations of working routines of stockpersons, Qualitative Behaviour Assessment of pigs and assessment of pig reactions to a human stranger. The results shows that the stockpersons included in the study performed more rough than gentle handling actions towards the pigs. However, the results could not demonstrate a significant relationship between either positive or negative human-animal interactions and pig behaviours indicative of fear or a positive emotional state. Nor was a relationship between stockperson beliefs and pig behaviour supported by the results, but the stockpersons had in general positive normative beliefs towards pigs and pig caretaking. Nevertheless, the results indicate that pigs may become less fearful in contact with human strangers the more time the stockperson spends with the pigs.

Keywords: animal handling, stockperson attitude, fear response, mental state, human-animal interaction, finishing pigs, qualitative behaviour assessment and fear assessment.

Sammanfattning

Denna studie är en del av ett pågående projekt, *PigTraWel* (2019), som syftar till att undersöka interaktioner mellan djurtransportörer och slaktgrisar under pålastning och avlastning inför slakt genom att kartlägga olika drivningsmetoder och deras effekter på grisar och transportörer samt effektiviteten av arbetet. Grisar utsätts för ett antal stressfaktorer i deras fysiska och sociala miljö före slakt som kan påverka deras beteende och välfärd, berörda djurskötares arbetssituation samt orsaka köttkvalitetsproblem. Tidigare studier visar att interaktionen mellan djurskötare och grisar kan påverka grisars beteenderespons när de hanteras inför slakt. Negativa interaktioner mellan människor och djur som sker på gården är relaterade till en hög nivå av rädsla bland grisar, medan positiva interaktioner mellan människor och djur har visat sig minska rädslan, underlätta framtida hantering och därmed ha fördelar för både djurhälsa och produktion. Grisar kan generalisera aversiv eller belönande hantering av en djurskötare och associera hanteringen med närvaron av människor. Syftet med denna studie var att undersöka djurskötares arbetsrutiner vid hantering av grisar på svenska kommersiella slaktgrisgårdar och hur specifika djurskötarbeteenden påverkar grisars beteende. Studien syftade även till att undersöka grisskötarnas normativa attityder jämtemot grisar och grisskötsel i förhållande till grisarnas beteenderespons. Tidigare forskning har visat att det finns ett samband mellan djurskötarens attityder och beteenden å ena sidan och grisars beteenderespons å den andra. Observationer utfördes på nio kommersiella gårdar utspridda i Sverige och data samlades in genom fyra olika metoder: en djurskötarenkät om attityder och uppfattningar om grisar och grisskötsel, observationer av grisskötarnas arbetsrutiner, kvalitativ beteende-bedömning av grisar och en bedömning av grisars reaktion till en främmande människa. Resultaten visar att de djurskötare som ingick i studien utförde fler negativa beteenden än positiva vid skötseln av grisarna. Studien kunde dock inte påvisa ett signifikant samband mellan positiva eller negativa interaktioner och grisbeteende som kunde antas indikera rädsla eller ett positivt känslotillstånd. Inte heller sambandet mellan djurskötarattityd och grisbeteende var statistiskt signifikant. Djurskötarna hade generellt positiva normativa attityder gentemot grisar och grisskötsel. Resultaten tyder på att grisar kan bli mindre rädda i kontakt med främmande människor, ju mer tid djurskötaren spenderar med grisarna.

Nyckelord: djurhantering, djurskötarattityd, rädslorespons, känslotillstånd, människa-djur interaktion, slaktgrisar, kvalitativ beteende bedömning och rädslobedömning.

Djurskötarens hanteringsstil kan påverka slaktgrisars beteende och känslotillstånd

Före slakt utsätts grisar för påfrestande förändringar i deras miljö som får dem att bli rädda och stressade. Höga nivåer av stresshormoner innan slakt kan resultera i ett kött av låg kvalitet, vilket kan påverka lantbrukarens och slakteriets lönsamhet negativt. Det finns forskning som visar att grisars tidigare upplevelser med människor påverkar deras tolerans mot de förändringar och den hantering de utsätts för före slakt.

Studien utfördes på nio grisgårdar i Sverige, där 9 djurskötare och 2795 slaktgrisar ingick. Den visar att djurskötarna utförde fler negativa än positiva beteenden mot grisarna när de sköttes och att grisar kan bli mindre rädda i kontakt med främmande människor, ju mer tid djurskötaren spenderar med grisarna.

Syftet med studien var att undersöka djurskötarnas arbetsrutiner vid hantering av grisar på svenska kommersiella grisgårdar och hur specifika djurskötarbeteenden påverkar grisars beteende. Studien syftade även till att undersöka djurskötarnas attityder gentemot grisar och grisskötsel i förhållande till grisarnas beteenderespons.

Tidigare forskning har visat att när människor hanterar grisar negativt, genom exempelvis slag, blir grisarna lättare rädda i kontakt med främmande människor.

Forskning har också visat att belönande hantering kan minska grisarnas rädsla och vara gynnsamt för både deras hälsa och produktivitet. Studier har även visat har visat att det finns ett samband mellan djurskötarens attityder och beteenden å ena sidan och grisars beteenderespons å den andra. Dessa samband kunde inte påvisas tydligt i denna studie, men generellt hade djurskötarna positiva attityder gentemot grisar och grisskötsel.

Trots att lantbruksdjur har genomgått flera tusen år av selektiv avel upplever många djur kontakten med människor och plöts-liga förändringar i sin sociala och fysiska miljö som skrämmande. Förutom att stress påverkar grisarnas tillväxt och hälsa negativt, kan stress före slakt försvåra hanteringen och ge upphov till ett kött av låg kvalitet.

Den bakomliggande orsaken till att grisar blir stressade i kontakt med andra människor är att de associerar människor med tidigare erfarenheter som antingen kan ha varit behagliga eller obehagliga.

Studien utfördes genom att djurskötarna i studien fick besvara en enkät om attityder och uppfattningar om grisar och grisskötsel. Djurskötarna observerades även under en vanlig arbetsdag när de skötte grisarna. Grisarna studerades genom en kvalitativ beteende-bedömning och ett test för att bedöma grisars reaktion i kontakt med en främmande människa.

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Abbreviations

Abbrevation	**Interpretation**
ADT	Avoidance Distance Test
DFD	Dark, Firm and Dry meat
HAR	Human Animal Relationship
PSE	Pale, Soft and Exudative meat
QBA	Qualitative Behaviour Assessment

1 Introduction

In Sweden, approximately 2.5 million pigs are slaughtered each year (Fransson, 2018). Finishing pigs are usually kept in the same pen under intensive conditions during rearing and are thus subjected to small environmental variations. Newborn piglets are kept in the farrowing unit together with the sow and during this period the contact between piglets and humans consist of regular supervision and procedures such as castration and vaccination. After approximately 4 weeks in the farrowing unit the pigs are transferred to the weaning unit where they are sorted and undergo a transition from sow milk to feed. When the pigs are about 12 weeks old and weigh 30 kg, they are transferred to the finishing unit. In the finishing unit the pigs are weighed and inspected daily until they are sent to slaughter when they are about 6 months old (Eskildsen & Vest Weber, 2016). Shortly before slaughter, pigs are exposed to a number of environmental changes (Geverink et al., 1998) that can affect pig behaviour and welfare, as well as the working situation for the stockpeople involved. Even though farm animals have undergone thousands of years of selective breeding many farm animals experience the exposure to humans and sudden changes in their social and physical environment as the most frightening event (Hemsworth & Coleman, 2011). Preslaughter treatment involves moving the pigs out of the pen, mixing of groups, loading onto the transport vehicle, journey, unloading, keeping in lairage and moving to the place of stunning (Geverink, 1998). Stress prior to slaughter can cause meat quality problems, such as pale, soft and exudative meat (PSE), which makes the meat unattractive and watery (Grandin, 1980).

Previous studies propose that on-farm interactions between stockperson and pigs have an important influence on the pigs' behavioural response during pre-slaughter treatments (D'Souza et al., 1998; Grandin, 1991). It was found that pigs that were handled aversively by the stockperson on the farm were fearful in contact with the abbatoir stockperson whereas pigs that were positively handled on-farm were unafraid and did not avoid the handler when approached (D'Souza et al., 1998).

Apart from the lack of interactions and reduced time spent with farm animals mainly caused by the prevailing intensification of animal production (Rushen et al., 1999), negative human-animal interactions, as aversive handling by the

stockperson, are related with a high fear response in pigs (Hemsworth et al., 1981a, b, 1986b, 1989; Pearce et al., 1989). Fear of humans is a major source of avoidance and stress in pigs and can thus lead to impaired pig production and welfare (Gonyou et al., 1986; Hemsworth et al., 1981, 1986b, 1987, 1989; Hemsworth & Barnett, 1991). Conversely, positive human-animal interactions, as gentle handling have been found to reduce animals fear response (Gonyou et al., 1986; Pearce et al., 1986; Hemsworth et al., 1981a, 1986b, 1987) and increase ease of handling, and thus to have benefits for health (Gross & Siegel, 1982) and production performance (English et al., 1999). Hemsworth et al. (1981b, 1994a, 1996a) suggest that pigs may generalize aversive treatment by one stockperson and associate the treatment with the presence of humans. Association between aversive treatment and humans could lead to further stress for the pigs at the abattoir (D'Souza et al., 1998).

This study is part of an ongoing project, *PigTraWel* (2019) which aims to investigate interactions between animal transporters and slaughter pigs during loading and unloading by mapping different driving methods and their effects on pigs and transporters and the efficiency of the work. To investigate whether pig-human interactions on-farm have an impact on pig's behavioural response during loading and unloading prior to slaughter, the stockpersons working routines and how these routines affect pigs behavioural response need to be identified.

1.1 Aim and hypothesis

The aim of this study was to examine stockpersons working routines during handling of pigs in Swedish commercial pig farms and how specific stockperson actions affect the behaviour and emotional state of the pigs and pigs behavioural response in contact with a human stranger. In order to investigate underlying causes of these stockperson handling actions, the study also aimed to examine normative beliefs towards pigs and pig caretaking in relation to pigs behavioural response.

Hypotheses:

- At farms where stockpersons perform more gentle and less rough handling actions, the pigs display behaviours indicative of more positive and less negative emotions.
- At farms where stockpersons perform more gentle and less rough handling actions, the pigs are less fearful to a human stranger.
- At farms where stockpersons have more positive normative attitudes towards pigs and pig caretaking, the pigs display behaviours indicative of more positive and less negative emotions.
- At farms where stockpersons have more positive normative attitudes towards pigs and pig caretaking, the pigs are less fearful to a human stranger.

2 Literature review

2.1 Human-Animal interactions

Modern intensive animal production involves several levels of interactions between stockpeople and their animals (Hemsworth & Coleman, 2011). A stockperson's tasks on a pig farm can be divided into daily routines and periodic routines. Daily tasks in the piggery involving interactions with the pigs usually include feeding, providing straw and health-related procedures while periodic tasks are conducted every 3 to 5 week and involves e.g. moving and weighing of pigs (Erwing, 2011).

In modern animal production, manual work has to some extent been replaced by labour-saving technologies and farms have become larger with larger herds. This reduces time spent with animals and many opportunities for positive interactions with livestock, such as manual feeding which have been replaced by mechanical feeders (Rushen et al., 1999). The estimated time spent per pig produced in a specialized slaughter pig herd is on average 9.9 minutes and in an integrated pig herd 14.4 minutes per pig produced (Erwing, 2011).

The environment in which the pigs are kept is detrimental for pig behaviour, welfare and production result. Besides environmental factors, such as air and water of good quality, acceptable pen hygiene, low noise levels, adequate lighting, moderate stocking density, straw access and acceptable feed structure (Ewing, 2011), previous studies indicate that the quality of human-animal interactions has an important influence on animal production and welfare. The impact of human-animal interactions on farm animals has been studied since the 1980s (Gonyou et al., 1986; Hemsworth et al., 1981a, b, 1986a, b, 1987, 1989; Pearce et al., 1989) and several studies indicate that negative human-animal interactions, as aversive handling by stockperson is related with a high fear response in pigs (Hemsworth et al., 1981a, b, 1986b, 1989; Pearce et al., 1989). Positive human-animal interactions are related with a reduced fear response and an increased tendency of pigs to approach humans (Hemsworth et al., 1981a, 1986b, 1987, 1996b, Gonyou et al., 1986; Pearce et al., 1989; Tanida et al., 1995; English et al., 1999; Tallet et al., 2014).

Studies also show a strong relationship between stockperson attitude and behaviour towards animals and fear of humans by farm animals and production performance (Waiblinger et al., 2002; Coleman et al., 1998; Hemsworth et al., 1989). The studies have shown that stockpersons with a positive attitude towards farm animals and animal caretaking show more gentle and less rough behaviours towards the animals than stockpersons with a negative attitude. Stockperson behaviour is an important determinant of animal's fear of humans and if an animal is fearful in interactions with humans there is an opportunity for the animal to experience an acute or a chronic stress response which places both the animal's productivity and welfare at risk.

2.1.1 The relationship between stockperson attitudes and handling

On-farm studies from Coleman et al. (1998) and Hemsworth et al. (1989) demonstrated that stockpeople that were responsible for the mating activities at commercial pig breeding farms and had a general negative attitude towards pigs and pig care used a higher proportion of negative physical interactions during pig handling than those stockpersons with a positive belief about pigs. Besides assessing stockperson attitude and behaviour, Hemsworth et al. (1989) also examined sow behaviour and reproductive performance in relation to stockperson attitude and behaviour. The authors found that farms where stockperson attitudes were negative had sows with a high level of fear of humans and a lower reproductive performance. Hemsworth et al. (1993) proposed a model for the human-animal relationship in livestock production (Figure 1). The model suggests that the more a stockperson behaves in a particular way, e.g. by handling pigs aversively, the more the stockperson attitude towards the behaviour will be reinforced. Also, the outcoming behavioural response by pigs will feed back to the stockperson's attitude since fearful pigs may be more difficult to handle and will thereby reinforce the stockperson's original attitude (Hemsworth & Coleman, 2011).

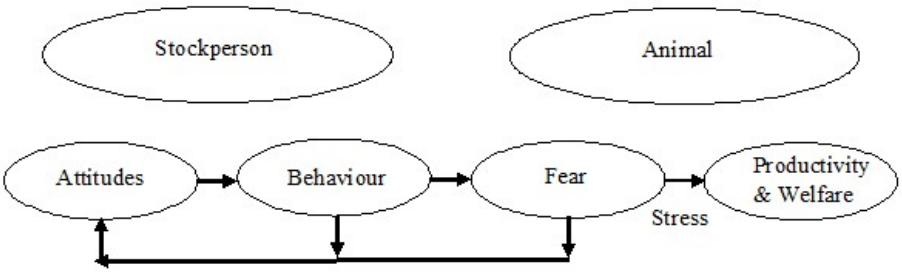

Figure 1. A model of human-animal relationship in livestock production (Hemsworth et al., 1993).

The underlying theory of this relationship was described by Ajzen and Fishbein (1980) as the theory of reasoned action. The theory proposes that a person's behaviour is under his or her volitional control and is a function of the persons attitude towards the behaviour and the subjective norm. Schifter and Ajzen (1985) described the theory of planned behaviour (Figure 2), which is an extension of the theory of reasoned action and considers a person's perceived behavioural control. A situation where the theory of planned behaviour is applicable is presented in a study by Coleman et al. (2003) where stockpeople at abattoirs think that they cannot engage in best practice in handling animals pre-slaughter because they believe that it is not consistent with the demands of an effective management that they keep up with. These two theories have provided a basis for predicting stockperson behaviour from attitudes.

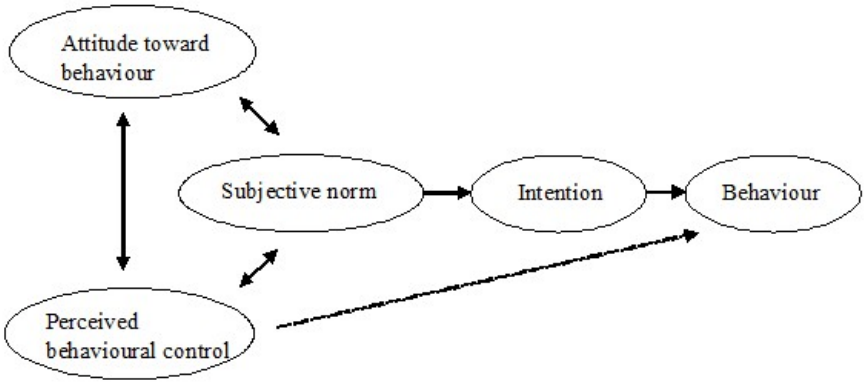

Figure 2. A model of the theory of planned behaviour (Schifter & Ajzen, 1985).

Hemsworth and colleagues (1994b) used a modification treatment on stockpersons from 25 commercial pig breeding farms with the purpose of investigating whether it was possible to improve stockperson attitude and behaviour towards pigs and if it had any effect on sow behaviour and reproduction. The treatment consisted of a cognitive-behavioural intervention procedure. It was possible to improve stockperson attitude towards pigs using the modification treatment, which led to a reduced

number of aversive human-pig interactions and an increase in number of positive physical interactions during pig handling. This resulted in a reduced fear response by pigs in contact with humans and a tendency for an increase in number of pigs born per sow per year (Hemsworth et al., 1994b).

2.1.2 Pig responses to stockperson handling

Interactions occur between stockperson and his or her stock which will form the basis of the complex social relationship that arise. Interactions between pigs and humans can occur through a number of sensory channels, such as tactile, visual, auditory and olfactory. Most research on human-animal interactions and their effect on pig behaviour has focused on tactile, visual and auditory contacts while olfactory cues have been studied to a very small degree (Hemsworth & Coleman, 2011).

Tactile contact

According to Hemsworth and Coleman (2011) it is the nature and number of interactions, and particularly those of tactile nature which determine the quality of the human-animal relationship for the animal. Pigs are social animals that interact physically with their keeper as well as the keeper physically interact with the pigs (Tallet et al., 2014). Tactile contact is an important part of pig-pig interactions and is often manifested by nosing, nibbling and huddling (Hafez, 1975). Tactile contact by stockperson is usually used in order to move pigs during routine husbandry procedures and negative tactile handling has been shown to increase pigs fear response (Tallet et al., 2014).

In studies were pigs regularly, but briefly were exposed to negative tactile interactions such as slaps, hits, kicks, pushes or prods with an electric goad whenever they approached or failed to avoid an experimenter were slower to approach and physically interact with the experimenter than pigs that received a gentle pat or a stroke whenever they approached the experimenter (Gonyou et al., 1986; Hemsworth et al., 1981a, b, 1986b, 1987, 1989; Pearce et al., 1989; Hemsworth & Barnett, 1991; Paterson & Pearce, 1992). Also, pigs exposed to negative tactile contact had an acute cortisol response in contact with humans (Hemsworth et al., 1981a, 1986b, 1987; Hemsworth & Barnett, 1991; Paterson & Pearce, 1992).

In general, pigs that received minimal tactile contact during these experiments were intermediate in their fear response to humans. However, Hemsworth et al. (1986b) found that pigs that usually experienced minimal tactile contact with stockperson, except for the limited contact during feeding and cleaning, experienced an acute stress response at the similar level as pigs exposed to aversive handling during human-pig interactions. Furthermore, Tanida et al. (1995) and Tallet et al. (2014) found that weanling pigs who received regular positive tactile contact by handler, such as gentle strokes and scratching, approached a human stranger more

frequently than pigs who received minimal tactile contact. In a study by de Oliveira et al. (2015) piglets that was regularly forced early with human handling using tactile stimulation reduced the piglets fear of humans and novel environments. English et al. (1999) performed an experiment on gilts and sows, that normally were treated well but handled minimally, by handling them in a pleasant manner. The pleasant treatment involved strokes or rubs for one minute per day for 7 days and after the treatment the pigs had a reduced fear response in contact with humans.

Visual contact

The most common interaction between pigs and humans occurs visually, but there is limited research on how visual contact with humans affects pigs. Human posture has been found to affect pig's behavioural response. Hemsworth et al. (1986a) found that pigs more frequently approached a stationary experimenter who was squatting and avoiding the pigs than an experimenter who was standing erect and approaching. Miura et al. (1996) also found that human posture, as well as human movement when approaching, affects pig's behavioural response. Weanling pigs exposed to a dummy lying face down interacted more frequently with it than when the dummy bent forward or stood straight. Pigs showed no avoidance behaviour as long as the human kept beyond a distance of 1.2 m and when the experimenter was moving away, but when the experimenter approached the pig's forwards, backwards and in a quadrupedal posture the pigs responded in fear (Miura et al., 1996).

Auditory contact

Stockpersons might use their voice during handling with the intention of interacting with their pigs. However, during husbandry procedures such as moving pigs within the stable or loading them into a truck, stockpeople often tend to shout, whistle or clap their hands with the purpose of making pigs move forward or faster (Courboulay et al., 2013). There is limited research on how pigs respond to sounds, but a study from Talling et al. (1996) indicated that pigs find loud, novel, intermittent sounds aversive. Research on how cattle respond to auditory contact with humans shows that cattle heart rate and movement increase when exposed to human shouting (Waynert et al., 1999). If the stockperson uses a calm voice in interactions with pigs, it would, according to Hulsen and Scheepens (2007), develop a positive human-pig relationship. Hemsworth et al. (1986a) found no significant difference in pig response when subjected to a recorded call by a human either using a loud, harsh voice or a silent, soft voice.

2.1.3 Pigs' perception of humans

Pigs' perception of humans, as well as the possible relationship that may have evolved, determines the behavioural response by pigs during human exposure

(Tallet et al., 2018). The authors suggested that pigs' perception of humans can be analyzed according to three interconnected layers. The first layer refers to the general experience with humans characterized as fearfulness or trust. The second layer relates to the discrimination between humans as familiar or unfamiliar. Finally, the third layer refers to the individual relationship that arises from recognition and emotional and behavioural responses from previous experience.

General experience with humans

An animal's capacity to adapt to the presence of humans has been an important trait during the domestication process of farm animals. This can be partly justified by the fact that domesticated animals exhibit a shorter flight distance compared to their wild ancestors (Vincent, 1960; Conner, 1975; Desforges & WoodGush, 1975). Even if handling is done in a gentle way, pigs may perceive it as a stressor (de Oliveira et al., 2015) since a large part of the contact that pigs have with humans usually consists of unpleasant treatments like castration, vaccination, tooth cutting and tail docking (Geverink et al., 1998).

Animals learn to predict stimuli by the process of conditioning (Broom & Fraser, 2015) and may associate the stockperson with either an aversive or a rewarding event during handling, which may represent the stockperson, and even other humans (Hemsworth et al., 1996a). Pigs exposed to rewarding events, such as food provision (Hemsworth et al., 1996a) or repeated gentle contact (Tallet et al., 2014; Tanida et al., 1995) often exhibit play behaviour or tail wagging, indicators of positive emotions and comfort in pigs (Reimert et al., 2013). Brajon et al. (2015) found that piglets previously handled in a pleasant manner interacted with a handler by exploring the handler with their snout almost continuously while in physical contact and by performing vigorous head movements, comparable with object shaking behaviour which is a behaviour associated with play (Newberry et al., 1988), while chewing and pulling on the handler's clothes (Brajon et al., 2015).

Anti-predator strategies are still seen in domestic animals (Broom & Fraser, 2015) and physiological reactions that occur in response to a perceived threat, such as an aversive event or novel stimuli, is either flight, fight or immobility (Boissy, 1995). Fear can be seen as an emotional state that arises when an individual perceives itself to be in actual danger (Broom & Fraser, 2015) or a motivational state that helps the animal respond to harmful stimuli (Hemsworth & Coleman, 2011), while anxiety arises from a perceived risk of a harmful event (Broom & Fraser, 2015). Common behavioural patterns seen among pigs expressed in a state of fear is high-pitched vocalization (Reimert et al., 2013) or alarming calls that are common among herd-living species (Boissy, 1995) together with freezing, ears back, tail low, escape attempts, defecating, urinating (Reimert et al., 2013), avoidance and unwillingness to move (Geverink, 1998). Fearfulness is considered as a personality trait that underlies how an individual respond to different threats

together with the individual perception of a particular situation (Boissy, 1995). de Oliveira et al. (2019) found that there is a large individual variation in how piglets responds to human handling and that it depends on underlying individual traits and piglets' early experiences. The authors also found that piglets change their reaction towards humans over time and the less reactive a pig became the more weight it gained. Apart from previous experiences and individual variation factors as age, sex, social rank and genetics influence an individual's fear response (Dwyer, 2004).

It has been suggested that group-housed animals, such as pigs, can sense emotional signals from their pen mates (Langford et al., 2006). Group-housed pigs may become distressed by receiving signals from a pen mate that is frightened or in pain from aversive handling and they may become positively excited by receiving signals from a pen mate that is feeling happy from pleasant handling (Reimert et al., 2015).

Discrimination and recognition of humans

Discrimination implies the ability to distinguish two or more components, while recognition is the ability to discriminate and identify individuals. The fact that discrimination occurs does not have to imply that recognition takes place (Mcleman et al., 2005), but scientific research has mainly focused on discrimination capacities because it is easier to measure scientifically (Tallet et al., 2018). Studies suggest that pigs possess the ability to discriminate between people based on their previous experience (Tanida & Nagano, 1998; Koba & Tanida, 1999). Pigs use auditory, visual and olfactory cues to discriminate between people, but visual and auditory cues seem to be more important than olfactory cues (Tanida & Nagano, 1998).

Experimental studies in which a handler represents a discriminative stimulus for choice of an animal in a maze, have demonstrated that pigs can discriminate between a handler and a stranger (Tanida & Nagano, 1998; Koba & Tanida, 1999). However, Hemsworth et al. (1981b, 1994a, 1996a) have reported that pigs may generalize the unconditioned stimulus that arises from aversive handling by a single human can extend to other humans. Hemsworth et al. (1994a) found that stimulus generalization in the behavioural response of pigs to humans occurred when pigs where briefly handled by a stockperson in a negative manner or briefly handled by stockpersons who markedly differed in their ways of handling the pigs.

2.2 Consequences of human-pig interactions

2.2.1 Pig welfare

According to Broom (1986), animal welfare can be defined as "an individual's state as regards its attempts to cope with its environment". An individual's state refers to the biological function, the subjective experience and the expression of natural

behaviours, covered by the five freedoms proposed by the UK Farm Animal Welfare Council in 1993 to protect welfare of animals (Broom & Fraser, 2015). These five freedoms signify that animals should be free from thirst, hunger and malnutrition; free from discomfort; free from pain, injury and disease; free from fear and distress; and free to express normal behaviours (Fraser, 2008).

If much effort is required for an animal to cope with its environment, as constant exposure to stressors, it is done at the expense of the animals biological functioning, affective state and normal behaviour which might lead to a reduced health, increased stress and abnormal behaviours, which are indicators of a reduced welfare (Broom & Fraser, 2015). Humans use animals for their own purposes and in exchange, from an ethical point of view, humans must assure the best available level of welfare to animals (Scipioni et al., 2009).

Aversive, and in some cases minimal, handling by a stockperson is significantly correlated with sustained elevation of free corticosteroids concentrations in pigs (Hemsworth et al., 1981a, 1986a, b, 1987; Hemsworth & Barnett, 1991; Paterson & Pearce, 1992). The underlying physiological process that is activated as an effect of fear is an acute stress response which causes the autonomic nervous system to respond by an activation of the sympathetic-adrenal-medullary (SAM) and the hypothalamic-pituitary-adrenal (HPA) axes. Activation of the SAM axis causes the brain to produce adrenaline and noradrenaline which increase the hearth rate, blood pressure and body temperature in order to prepare the animal to take action. If the exposure to the perceived threat continues, the HPA axis will activate and respond by stimulate a secretion of corticosteroids in the adrenal cortex (Sjaastad et al., 2010). Constant exposure to stressors induces a chronic stress response, a prolonged activation of the HPA-axis and a sustained elevation of free corticosteroids in blood (Hemsworth & Coleman, 2011). Elevated levels of corticosteroids suppress the release of growth hormone and may lead to immunosuppression through a redistribution of white blood cells (Sjaastad et al., 2010).

2.2.2 Secondary effects on productivity

Frequent and positive human-pig interactions are associated with a reduced fear response in pigs and may facilitate animal handling (English et al., 1999), while negative human-pig interactions are related to fear (Hemsworth et al., 1981a, b, 1986b, 1989; Pearce et al., 1989). Fearful pigs that try to escape or become immobile during handling can become more difficult to handle later on. Also, fearful pigs that try to avoid human contact during handling might injure themselves. With easier animal handling stockpersons will most likely experience an improved work satisfaction which in turn can improve the stockpersons attitude towards pigs (Hemsworth & Coleman, 2011).

Human-pig interactions on farm can also influence pig's stress response to pre-slaughter handling and thus affect meat quality (D'Souza et al., 1998). Post-mortem pH-value in muscle tissue is crucial to meat quality and is affected by the breakdown of glycogen to lactic acid. Acute stress prior to slaughter is associated with an increase of glycolysis which causes lactic acid to rapidly accumulate, resulting in pH-value in muscle tissue to decline quickly early after stunning while the body temperature is still high. This leads to protein denaturation resulting in a pale, soft and exudative meat (PSE) with low water holding capacity (Grandin, 1980). If animals are exposed to long-term stress, the glycogen reserves may be depleted at slaughter and sufficient lactic acid cannot be accumulated and the desired pH reduction is not achieved. This leads to a dark, firm and dry meat (DFD), which makes the meat unattractive with dark colour and sticky texture (Scheffler & Gerrard, 2007). Low-quality meat is usually not accepted among consumers and leads to poor processing (Geverink, 1998) and can affect profitability for different parties throughout the production chain.

D'Souza et al. (1998) found that pigs exposed to aversive handling by stockpersons on farm, were highly fearful when approached by the abattoir stockperson, whereas pigs positively handled on farm were much less afraid of the handler. Pigs that were handled aversively on farm also had lower muscle glycogen concentrations post slaughter compared to pigs positively handled on farm. In a study by Grandin & Curtis (1985) (in Geverink et al., 1998) it was found that regularly petted pigs were less reluctant to move through a chute pre slaughter and Lensink et al. (2001) found that dairy calves that received positive handling during rearing had lower heart rates during loading for transport than calves handled minimally or negatively.

2.3 Measuring indicators of animal welfare

Welfare assessment should be applied and feasible to use at both farms, transport and abattoir (Blokhuis et al., 2003). Resource-based, management-based and animal-based measures have been used to assess indicators of pig welfare. Resource-based measures refer to the measurements made on the environment where the animals are kept. Management-based measures refer to routines the unit manager performs that could impact animal welfare and animal-based measures refers to measurements performed directly on the animal (Welfare Quality®, 2009). Behaviour is one of the most easily observed indicators of welfare since it provides information about animal's needs, preference and internal state (Mench & Mason, 1997).

2.3.1 Fear assessment

In studies where pigs' behavioural responses have been related to human-pig interactions (Hemsworth et al., 1981a, b, 1986b, 1989; Pearce et al., 1989) the level of fear has been assessed by measuring the amount of avoidance of the experimenter or, conversely, the amount of approach to the experimenter. The reason for this assessment is that while there are number of behavioural patterns available for the animal that may be equally important in the fear-provoking situation, the amount of avoidance or approach presents an integrated measure of the fear levels without demanding judgements about significance of specific behavioural patterns (Hemsworth & Coleman, 2011).

2.3.2 The Welfare Quality® protocol

The Welfare Quality® project (Welfare Quality®, 2009) developed a detailed assessment protocol with the aim to safeguard and improve animal welfare along the food chain. The protocol are based on science and four main principles; Good feeding, Good housing, Good health and Appropriate behaviour and the four principles are identified by 12 criteria: absence of prolonged hunger, absence of prolonged thirst, comfort around resting, thermal comfort, ease of movement, absence of injuries, absence of disease, absence of pain induced by management procedures, expression of social behaviour, expression of other behaviours, good human-animal relationship and positive emotional state. (Welfare Quality®, 2009). The criteria make the whole process transparent and can beneficially be used by farmers to improve animal welfare (Botreau et al., 2007). The protocol present high variability and allows discrimination among conventional farms. It's easy to perform and requires little input from the farmer (Temple et al., 2011).

2.3.3 Qualitative Behaviour Assessment (QBA)

Qualitative Behaviour Assessment (QBA) has been developed as a part of the Welfare Quality® assessment protocol to assess the mental state of animals in a group. The method is performed by subjectively evaluating the expressive quality of pig behaviour and emotional state, i.e. body language, through 20 descriptors that are scored on a 0-125 mm visual analogue scale, where 0 indicates that the expressive quality indicated by the term is entirely absent in the observed pigs and 125 indicates that it is ubiquitously dominant (Welfare Quality, 2009). Recognition of this expressive quality encompasses individuality, personality and emotionality of animals to analyse their experience of life (Wemelsfelder, 2007). Research supports the scientific validity of assessing the expressive body language of farm animals and QBA has been evaluated as a practical animal welfare assessment tool. Evaluators perceived the method as convenient to apply to assess the expressive quality of

behaviour and emotional state and showed good agreement in their assessments (Wemelsfelder, 2005 in Wemelsfelder, 2007; Wemelsfelder et al., 2015).

3 Material and methods

3.1 Animals, stockpersons and housing conditions

Eighteen conventional pig farms in Sweden that were connected to the *PigTraWel*-project (PigTraWel, 2019) were asked if they wanted to participate in this study. Nine out of 18 farms approved, and 2795 finishing pigs kept in 308 pens were included in the study. Five of the studied farms were located in the southern of Sweden, one farm in central Sweden and three farms in northern Sweden. The observations were made in one section at each farm, either in the section from which pigs were delivered in the *PigTraWel*-project or another section, with pigs that would be delivered for slaughter within 1 to 6 weeks. Nine stockpersons that usually worked in the selected section at each farm volunteered to participate in the study. The pigs included in the study were three-breed crosses of either (LY)H or (LY)D and were about 20 to 25 weeks of age. The pigs were kept in pens of either long or cross trough type. The group size varied, ranging from 3 to 16 pigs per pen. All of the pigs had access to straw in varying amounts (Table 1) and were given wet feed. Data were collected by four different methods: a stockperson questionnaire of beliefs and perceptions, observations of working routines of stockpersons, Qualitative Behaviour Assessment of pigs and assessment of pig reactions to a human stranger. All observations were made by the author, except the Qualitative Behaviour Assessment which was performed by an experienced research technician.

Table 1. Information about the nine farms[1]

Farm	Location in Sweden	Production system	Number of pens	Number of pigs	Pen type	Number of stockpersons	Feeding	Amount of straw provided	Stable built year
1	North	Specialized	46	440	Long trough	3	Wet	1 armful	2008
2	North	Specialized	20	162	Long trough	3	Wet	2 armful	2000
3	North	Specialized	18	196	Long trough	2	Wet	2 handful	2001
4	South	Integrated	48	510	-	2	-	1-2 armful	2009
5	Center	Integrated	20	195	Cross trough	2	Wet	2-3 armful	2001
6	South	Specialized	52	357	Long trough	2	Wet	1-2 armful	1971
7	South	Specialized	31	335	Cross trough	3	Wet	2-3 armful	1980
8	South	Specialized	40	350	Cross trough	3	Wet	3 armful	1980
9	South	Integrated	34	250	Long trough	2	Wet	2-3 armful	1970

3.2 Recordings

The stockperson who usually worked in the studied section was given a questionnaire (Appendix 1) consisting of totally 43 questions about beliefs and perception to pigs and pig caretaking. The questionnaire was previously developed and used in research at the University of Melbourne, Australia (Paul H. Hemsworth, pers. comm., 2018-11-26) and the questions covered general beliefs towards pigs, perceived difficulty and efforts to handle pigs in different situations and habits of interacting with the pigs. Eleven questions concerned normative beliefs were used in this study. The response values were graded on an ordinal 5-level scale.

The stockperson was also observed once during one working day when he or she was performing daily routines in the section. The observer followed the stockperson

[1] - = data missing.

when he or she was performing tasks such as regular supervision, manure scraping or provision of straw to the pigs. In every pen it was recorded (Appendix 2) whether the stockperson entered the pen or not and the number of times the stockperson performed positive tactile interactions with the pigs, categorized as: scratching, stroking, touching or patting gently with hand, and the number of times the stockperson performed negative tactile interactions, categorized as: slapping, clapping/pushing hard with hand, touching with tool, kicking/restricting movements by using own body. The number of vocal interactions made by stockperson, as talking in conversation tone, talking/shouting with a loud voice and whistling was also recorded and the number of pigs that made av high-pitched vocalization. The number of positive and negative interactions per pig was calculated for each pen and the mean of these values across all pens was denoted $Interact_{pos}$ and $Interact_{neg}$ respectively.

Immediately after the stockpersons working routines had been observed the QBA assessment (Appendix 3) was performed. To cover all parts of the section, five observation points were selected (near each corner and center). Before the observations started, a 2-minute acclimatization was allowed, and the assessment lasted for 2 minutes per observation point. The QBA was performed according to the Welfare Quality® Assessment protocol for pigs (Welfare Quality®, 2009) and immediately after the observation the expressive quality of the pigs' behaviour and emotional state was assessed by 20 terms (Table 1) that were graded on a 0-128 mm visual analogue scale where 0 corresponds to the weakest possible and where 128 corresponds to the strongest possible.

To measure pigs' fear of humans, one human-animal relationship test (HAR) and one modified avoidance distance test (ADT) were performed (Appendix 4). The research technician, a female who wore a blue overall, dark green boots and a white dust filter mask represented the human stranger. Ten pens in the section were selected randomly.

In order to investigate whether pigs show a panic response or not in contact with a human stranger, the HAR-test was performed according to the Welfare Quality® Assessment protocol for pigs (Welfare Quality®, 2009). The research technician entered the pen and slowly walked around the group of pigs without initiating any contact, stopped at the starting point, stood still erect for 30 seconds and then slowly walked back in the opposite direction. It was recorded how many of the pigs' in the pen that showed a panic response, i.e. number of pigs fleeing, facing away or huddling in a corner of the pen. The mean proportion of pigs in the ten pens showing this behaviour was denoted *HAR*.

The second test performed was a modified ADT test described in the Welfare Quality® Assessment protocol for poultry (Welfare Quality®, 2009), aimed to investigate how many pigs that would approach a human stranger. The second test was performed immediately after the first test and the research technician stood still

erect and held out her arms for 30 seconds at the starting point. Pigs that were within an arm's length from the technician was touched gently and the number of pigs that the technician where able to touch was registered. The mean proportion of pigs in the ten pens showing this behaviour was denoted *modADT*.

3.3 Statistical analyses

Editing and preparation of all data were done in Microsoft Office Excel 2018. The farm was used as the unit of analysis. By summarizing the amount of interactions per farm, positive and negative respectively, and divide the sum by number of pigs at each fam, mean values ($Interact_{pos}$ and $Interact_{neg}$) for the number of interactions per pig could be obtained for each farm.

According to Welfare Quality® protocol for pigs (Welfare Quality®, 2009), the analogue scale for the individual terms in the QBA protocol must be 125mm. On the protocol used in this study (Appendix 3), the analogue scales was estimated to 128mm and in order to get a correct index formula the values were adapted by multiplying all values by 125/128. Twenty descriptors in the QBA assessment were classified as either positive or negative (see Table 2) and the 20 term values obtained at each farm were turned into an index by a weighted sum, according to Welfare Quality® (2009):

$$I_{QBA} = -4.5367 + \sum_{k=1}^{20} W_k N_k$$

Where N_k is the value obtained for a farm for a given term k and weight W_k attributed to k. Weights are summarized in Table 2. The index was transformed into a QBA score using the I-spline function:

$$Score_{QBA} = 0.5 + \left(0.11667\ x\ I_{QBA}\right) - \left(0.0055556\ x\ {I_{QBA}}^2\right).$$

All scores above 1 were limited to a maximum value of 1. The score was interpreted as the mean level of positive mental states in the pigs and used for further analysis.

Table 2. Positive and negative descriptors in the QBA assessment and weights to obtain an index (Welfare Quality®, 2009).

Positive terms	Weights *W*	Negative terms	Weights *W*
Active	0.01228	Agitated	-0.00711
Relaxed	0.01087	Tense	-0.00971
Fearful	0.00475	Frustrated	-0.01496
Calm	0.01122	Bored	-0.01230
Content	0.01184	Listless	-0.01448
Enjoying	0.01030	Indifferent	-0.00747
Sociable	0.00544	Irritable	-0.00883
Playful	0.00463	Aimless	-0.01193
Positively occupied	0.01193	Distressed	-0.01175
Lively	0.01002		
Happy	0.01193		

By summarizing number of pigs on the farm that displayed a panic response in contact with a human stranger and divide the sum with number of pigs at each farm, mean proportion for *HAR* where attained.

Response values obtained from the questionnaire about normative beliefs and perceptions to pigs and pig caretaking were turned into an index I_{norm}. After reversing the scale for negative beliefs (questions 4, 8, 26, 15 and 6), the average of the 11 response values was subtracted by 1 and then divided by 4 to produce index values between 0 and 1, which were easier to interpret and analyse.

Statistical analyses were performed in Minitab Statistical Software version 18 (2018). Descriptive statistics of all variables were calculated. The relationships between, on the one hand, stockpersons beliefs and handling actions and, on the other hand, pig behaviour and mental state were analysed by Spearman rank correlation and illustrated by scatter plots. Spearman rank correlation was used as analysis method because the values where not normally distributed. The following relationships were analysed: $Interact_{pos}$ x $Score_{QBA}$, $Interact_{neg}$ x $Score_{QBA}$, $Interact_{pos}$ x *HAR*, $Interact_{neg}$ x *HAR*, I_{norm} x $Score_{QBA}$ and I_{norm} x *HAR*. The level of significance was set to 0.05.

4 Results

4.1 Descriptive statistics

The average time spent by stockpersons per pen in the sections was 49.5 seconds (Table 4), with the longest duration of 174.5 seconds (Table 3) and the shortest 19.6 seconds. Also, stockpersons entered in average 37% of the pens in the section, one stockperson entered all of the pens in the section and one stockperson did not enter any of them. The stockperson that entered none of the pens during observation also spend the shortest time per pen (19.6 seconds) and had the second largest proportion of pigs that displayed a panic response in contact with a human stranger (61%). The stockperson who spent the longest time in the section (174.5 seconds) and entered all the pens, also performed the largest number of positive interactions and had the smallest proportion of pigs displaying a panic response in contact with a human stranger. The stockperson who performed the second largest number of positive interactions towards the pigs also had the second smallest proportions of pigs exhibiting a panic response during contact with a human stranger and the stockperson that performed the largest number of negative interactions towards the pigs didn't perform any positive interactions.

Out of the nine stockpersons who participated in the study, four stockpersons performed any of the interactions classified as positive during the observations and the most common positive interaction performed was laying hand on pig. Interactions classified as negative were performed by all subjects except the stockperson who did not enter any of the pens in the section during the observation. The most commonly performed interaction classified as negative was slapping or clapping/pushing hard with hand on pig followed by touching with tool on pigs' head/body. The mean value for positive normative beliefs among the farms was 0.67, where the highest was 0.82 and the lowest was 0.36.

A total of nine pigs from all farms made a high-pitched vocalization during interactions with the stockperson. The results from the qualitative behaviour assessment shows that pigs had a high mean score (0.95), but on two of the included farms the automated feeding system started during the QBA assessment. There was a variation regarding the level of pigs' fear response in contact with a human stranger, both between pen mates, between pens in a section and between farms. Some pigs fled, faced away from the research technician or huddled in a corner of the pen, and

others responded in such a panic that they fell to the floor when they tried to escape the research technician.

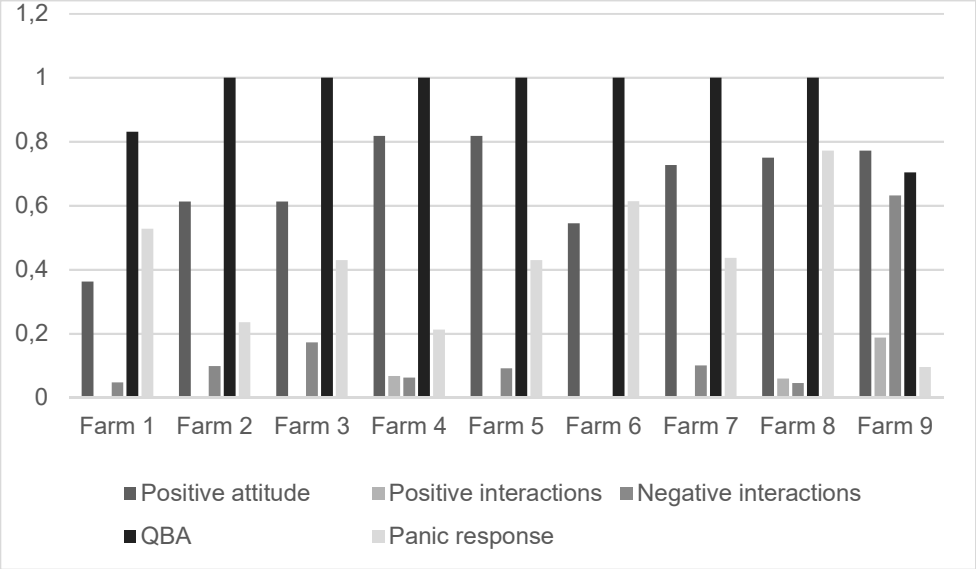

Figure 3. Different measures at the nine farms. $Interact_{pos}$ = Positive interactions, $Interact_{neg}$ = Negative interactions, $Score_{QBA}$ = QBA, *HAR* = Panic response and I_{norm} = Positive attitude

Table. 3. Summary of results from the nine farms

Farm	Time/pen, sec	Proportion of entered pens	$Interact_{pos}$	$Interact_{neg}$	I_{norm}	$Score_{QBA}$	*HAR*	*modADT*
1	26.1	0.28	0.005	0.048	0.36	0.83	0.53	0.49
2	60.0	0.65	0.000	0.099	0.61	1.00	0.24	0.80
3	20.0	0.11	0.000	0.174	0.61	1.00	0.43	0.67
4	36.3	0.10	0.069	0.063	0.82	1.00	0.21	0.90
5	45.0	0.90	0.000	0.092	0.82	1.00	0.43	0.54
6	19.6	0.00	0.000	0.000	0.55	1.00	0.61	0.77
7	25.2	0.03	0.000	0.102	0.73	1.00	0.44	0.72
8	39.0	0.22	0.060	0.046	0.75	1.00	0.77	0.32
9	174.5	1.00	0.188	0.632	0.77	0.70	0.10	0.67

Table 4. Descriptive statistics of all variables (n=9)

Variable	Mean	StDev	Minimum	Median	Maximum
Time/pen, sec	49.5	48.7	19.6	36.3	174.5
Proportion of entered pens	0.37	0.38	0.00	0.23	1.000
Interactpos	0.0357	0.0635	0.0000	0.0000	0.1880
Interactneg	0.1394	0.1909	0.000	0.0923	0.632
Inorm	0.67	0.150	0.36	0.73	0.82
ScoreQBA	0.95	0.107	0.70	1.00	1.00
HAR	0.42	0.211	0.10	0.43	0.77
modADT	0.66	0.180	0.32	0.67	0.91

4.2 Correlations

No significant correlation was found between either $Interact_{pos}$ or $Interact_{neg}$ and a high $Score_{QBA}$. Nor was any significant relationship found between $Interact_{pos}$ and *HAR*, or between $Interact_{neg}$ and *HAR*. I_{norm} could not be shown to be significantly associated with either a high $Score_{QBA}$ or *HAR*.

5 Discussion

The aim of this study was to examine stockpersons working routines during handling of pigs in Swedish commercial pig farms and how specific stockperson handling actions affect the behaviour and emotional state of the pigs and the pigs' behavioural response in contact with a human stranger. In order to investigate underlying causes of these stockperson handling actions, the study also aimed to examine stockpersons normative attitudes towards pigs and pig caretaking.

The results shows that the stockpersons included in the study performed more rough handling actions (mean 0.14 interactions/pig) than gentle (mean 0.036 interactions/pig) towards the pigs. There was no significant correlation between a low score in the QBA assessment and stockpersons performing more negative handling actions towards the pigs. Now was there any significant relationship between positive interactions by stockpersons and a high score in the QBA assessment. No significant relationship was found between positive interactions and a low frequency of pigs displaying a panic response in contact with a human stranger. Nor was negative interactions found to be associated with a high number of pigs displaying a panic reponse.

These data do not confirm what previous studies have found (Hemsworth et al., 1981a, 1986b, 1987, 1989, 1996b; Gonyou et al., 1986; Pearce et al., 1986, 1989; Tanida et al., 1995; English et al., 1999; Tallet et al., 2014). Nor do the data confirm the hypotheses; that if a stockperson performs more gentle and less rough handling actions towards the pigs, the pigs will display behaviours indicative of more positive than negative emotions and less fear in contact with a human stranger.

In most of the studies where human handling has been related to pig behaviour, the interactions occured between pigs and an experimenter. In all of the reviewed studies, except for the one by Hemsworth et al. (1989), the pleasant handling consisted of a treatment where the pigs were gently stroked whenever they approached an experimenter and the unpleasant handling consisted of aversive tactile treatments. As in this study, Hemsworth et al. (1989) examined the relationship between the stockpersons handling actions and the pigs' behavioural response. Since the correlation in the previous studies was often based on human-animal interactions between experimenter and pig together with the fact that only four out of nine

stockpersons included in this study performed any of the interactions classified as positive during the observations and to a small extent, which made it difficult to demonstrate the relationship in this study. There may also be a risk that the stockpersons behaved differently, and used rougher or gentler handling actions towards the pigs than they usually do because they were aware of the fact that they were observed.

The relationship between positive interactions by stockpersons and the modified ADT-test, aimed to investigate how many pigs that would approach a human stranger. Relationships with this measure, were not tested statistically because *modADT* was not a widely accepted and validated measure. The test was developed by Welfare Quality® (2009) to assess poultry's fear of humans. Hemsworth et al. (1986a) found that pigs more frequently approached a stationary experimenter who was squatting than an experimenter who was standing erect. In the modified ADT-test the research technician had to stand erect rather than squatting because some of the pigs became intrusive which put the research technician at risk.

There was no significant association between a high proportion of pigs displaying a panic response in contact with a human stranger and stockpersons performing more rough handling actions towards the pigs. However, the stockperson that entered none of the pens and spent the smallest amount of time per pen (19.6 seconds) also had the second largest proportion of pigs that displayed a panic response in contact with a human stranger. In contrast, at the farm where the stockperson spent the longest time per pen (174.5 seconds) and entered all of the pens in the section had the smallest proportion of pigs that displayed a panic response in contact with a human stranger. The same stockperson also performed the largest amount of both positive and negative interactions towards the pigs. Moreover, both integrated and specialized production systems were included in this study. It was estimated that more time is spent per pig produced in an integrated production system (14.4 minutes) than in a specialized pig herd (9.9 minutes) (Erwing, 2011). This may mean that pigs are more accustomed to stockperson handling and the presence of humans in integrated systems.

Hemsworth et al. (1986b) found that pigs that have minimal tactile contact with stockpersons experience an acute stress response of similar magnitude as pigs exposed to aversive handling during human-pig interactions. Also, Tanida et al. (1995) and Tallet et al. (2014) found that pigs who receive minimal tactile contact by stockpersons approach a human stranger less than pigs that receive gentle contact by the stockpersons. Hemsworth et al. (1986b) suggested that unfamiliarity with humans may have been the explanation for the response and since long it is known that novel stimuli is one of the most potent conditions leading to stress and negative emotional responses (Boissy, 1995). De Oliveira et al. (2015) found that piglets regularly given tactile stimulation during human handling early in life reduced the piglets fear of humans and novel environments.

The results from this study suggest that the more time the stockperson spends with the pigs, and thus creates opportunities for interactions to occur, the less fearful the pigs become in contact with human strangers. Also, the time spent with pigs may be as important as the nature of stockpersons handling actions for pig behaviour and emotional state. Stockpersons responsible for farm animals should take into consideration that pigs negative behavioural and emotional responses to novel stimuli can be reduced by repeated contact, preferably early in the pig's life.

There was a considerable variation between farms regarding the level of handling roughness in terms of tactile negative interactions. Most of the stockpersons used negative handling actions towards the pigs in order to get them to stand up straight so that the stockperson could make a quick visual health check. Some of the stockpersons used negative tactile or vocal handling actions with the purpose of getting the pigs to move and stay out of the away.

There was also variation regarding the level of pigs' fear response in contact with a human stranger, both between pen mates, between pens in a section and between farms. Some pigs fled, faced away from the research technician or huddled in a corner of the pen, and others responded in such a panic that they fell to the floor when they tried to escape the research technician. It is noteworthy that some pigs respond so strongly to the presence of humans that they are at risk of injuring themselves. Moreover, there may be a variation regarding how strongly pigs respond to human presence depending on the pigs' genotype, their social rank, age and sex (Dwyer, 2004). De Oliveira et al. (2019) found that there is large individual variation in how piglets responds to human handling and that it depends on underlying individual traits and the piglets' early experiences. Also, environmental factors have an important influence on pig behaviour (Ewing, 2011) and may thus have affected the results of this study. The pigs were housed in two different pen types (long trough or cross trough) and had varying access to straw. Also, the stables that the pigs where kept in was built during different decades, which may mean that the pigs where reared in environments with different conditions regarding stable climate and interior design. The group size in each pen varied, ranging between 3-16 pigs in each pen, which means that the accessible floor area varied.

Welfare Quality® (Welfare Quality®, 2009) recommended that the HAR-test should be performed on at least 150 pigs from 10 pens at each farm. In this study 10 pens were randomly selected at each farm, and the group size in each pen included in the HAR-test varied from 7 to 12 pigs. Varying group sizes between pens meant that some of the pigs had larger space allowance than others. With increased space allowance the pigs will have larger opportunity to get away from each other and avoid aggressive situations. Also, the fewer pigs in a pen, the more space they have at the feeding trough and there may be a greater opportunity for interactions to take place between stockperson and pigs.

Studies has shown that stockpersons with a positive attitude towards pigs and pig caretaking display more gentle and less rough handling actions towards the animals than stockpersons with a negative attitude (Hemsworth et al., 1989; Coleman et al., 1998; Waiblinger et al., 2002). In this study, stockpersons normative beliefs were examined in relation to pig behaviour and the stockpersons had, in general, a positive normative attitude towards pig and pig caretaking (mean score 0.67). However, there was no significant correlation between positive normative beliefs towards pigs and pig caretaking by stockpersons and a high score in the QBA assessment, nor between positive normative beliefs held by stockpersons and a low frequency of pigs displaying a panic response in contact with a human stranger. Thus, this study cannot confirm the relationship that researchers have found previously between the stockperson beliefs and actions and the pigs' behavioural response (Hemsworth et al., 1989; Coleman et al., 1998; Waiblinger et al., 2002).

The cited previous studies included data from a much larger number of pigs and stockpersons. Also, the significant relationship in these studies where not only based on normative beliefs, but also behaviour and control beliefs held by stockpersons, variables that were not statistically tested in this study. In addition, Waiblinger et al. (2002) examined stockperson beliefs towards dairy cows and cow caretaking while Hemsworth et al. (1989) and Coleman et al. (1998) examined stockperson beliefs concerning sows and mating activities, while this study concerned stockperson normative beliefs about fattening pigs. As mentioned, age can have an important influence on how pigs respond to human stimuli (Dwyer, 2004). Sows have a longer lifespan than fattening pigs and can thus experience human presence to a greater extent and be more used to human handling than fattening pigs. In addition, stockpersons responsible for sow care can have a different perception of pigs than stockpersons responsible for fattening pigs.

On two of the included farms the automated feeding system started during the QBA assessment, which may have affected pig behaviour and the study results. Also, the observation in this study lasted for 2 minutes per observation point, while the Welfare Quality® protocol for pigs (Welfare Quality®, 2009) recommend that the duration of observation should be performed for 4 minutes per observation point if 5 observation points is selected. However, Qualitative Behaviour Assessment has previously been evaluated to be a validated method to assess the expressive quality of behaviour and emotional state of farm animals (Wemelsfelder, 2005 in Wemelsfelder, 2007; Wemelsfelder et al., 2015). QBA requires a certain amount of training and experience to generate results (Wemelsfelder, 2007) and in this study the assessment tool was performed by a research technician who was experienced with regard to both pig behaviour and its assessment.

In previous studies that have demonstrated a significant relationship between the quality of human-animal interactions and the behavioral response of farm animals, the human subject was an experimenter. Therefore, future on-farm research should

be performed to examine how stockpersons handling actions affect pigs fear response and emotional state. It is suggested that future research should be carried out to investigate how influential individual pig factors, including breed, are for the ability of pigs to cope with the environment, manage environmental challenges and how these factors affect pigs behavioural response in contact with humans. There is a lack of research that has examined the relationship between stockperson attitude and action and its relation to fattening pigs behaviour. Moreover, this study only examined the relationship between stockpersons normative beliefs and pig behaviour. Further research should be performed to investigate the relationship between stockpersons attitude and action and how it affects fattening pigs behaviour and production. In addition, stockpersons attitudes towards behavioural actions and perceived behavioural control should be included in the research.

Farms included in this study were not randomly selected; 18 farms connected to *PigTraWel* were asked if they wanted to participate and 9 farms were willing to do so. Because the samples of study farms were not random, it might not be representative for commercial finishing pig farms in Sweden which entails a risk for bias. Future research, similar to this study, should be conducted on randomly selected farms, if possible. However, the presented descriptive results may be important in order to get an idea of how the interactions between stockpersons and pigs in Swedish commercial pig farms appears. Time spent per pig and the proportion of entered pens seems to have an impact on the pigs' behavioural response in contact with a human stranger. This suggests that further research should investigate if it is possible to reduce pigs fear towards human handlers by spending more time in contact with the pigs.

6 Conclusion

This study shows that stockpersons in Swedish commercial finishing pig farms perform more rough than gentle handling actions towards the pigs. The stockpersons had, in general, more positive normative beliefs towards pigs and pig caretaking. None of the hypothesized relationships could be confirmed statistically. Nevertheless, there was some indication that pigs may become less fearful in contact with human strangers the more time the stockperson spends with the pigs. This may suggest that the time for caretaking is equally important as the quality of interactions between stockperson and pigs in order to achieve a decreased fear and an increased positive emotional state in finishing pigs. However, this needs to be investigated further.

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Appendix 1

Questionnaire Part 1

Please respond to each statement in terms of a five-point scale defined by the labels:
Disagree strongly; Disagree; Neither agree nor disagree; Agree; Agree strongly.

	Tick most appropriate category				
Statements	Disagree Strongly	Disagree	Neither agree nor disagree	Agree	Agree Strongly
1. Pigs are easy animals to work with					
2. Pigs are noisy animals.					
3. Pigs are curious animals.					
4. Pigs are stubborn animals.					
5. Pigs are smelly animals.					
6. Pigs don't feel pain like humans.					
7. Pigs have a gentle nature.					
8. Little experience is required to work with pigs.					
9. Pigs are a pleasure to work with.					
10. Pigs are fun-loving animals.					
11. Pigs could make good pets.					
12. Pigs have dirty habits.					
13. Pigs are entertaining to watch.					
14. Pigs are intelligent animals.					
15. Pigs have an ugly appearance.					
16. People should talk to their pigs.					
17. Pigs are greedy.					

Tick most appropriate category					
Statements	Disagree Strongly	Disagree	Neither agree nor disagree	Agree	Agree Strongly
18. Baby pigs are energetic.					
19. Pigs are easy to train to a routine.					
20. Pigs are easily frightened when handled forcefully.					
21. Pigs are simple-minded.					
22. Pigs require respect.					
23. Pigs are aggressive to their own kind.					
24. Pigs are gluttons.					
25. Pigs are stubborn animals.					
26. Pigs are frustrating to work with.					
27. Pigs are dirty animals.					
28. Pigs are friendly towards people.					
29. Little training is required to work with pigs.					
30. Pigs are stimulating animals.					
31. Pigs are easy to handle.					

Questionnaire Part 2

Please answer each question by marking a number according to scale 1-7 presented below.

1. How difficult are pigs to handle?

Very Difficult to Handle						Easy to Handl
1	2	3	4	5	6	7

2. How often do you pet (eg cliffs, strokes, pats) your pigs while handling them?

Daily			Occasionally			Never
1	2	3	4	5	6	7

3. How much physical effort (for example, pushing, prodding, hitting) do you need to use when moving your pigs?

A lot						Very little
1	2	3	4	5	6	7

4. How often do you talk to your pigs while handling them?

Daily			Occasionally			Never
1	2	3	4	5	6	7

5. How much verbal effort (for example, shouting etc.) do you need to use when moving your pigs

A lot						Very little
1	2	3	4	5	6	7

6. How many of your pigs have names or numbers that you remember well?

All of them						None of them
1	2	3	4	5	6	7

7. How much variation in temperament do your pigs have?

A lot						None
1	2	3	4	5	6	7

8. How well do your pigs recognise you compared to strangers?

Very well					No special recognition	
1	2	3	4	5	6	7

9. How do you feel about frequent patting or stroking of pigs?

	Good						Bad
A	1	2	3	4	5	6	7
	Wise						Foolish
B	1	2	3	4	5	6	7

10. What do you think other farmers feel about patting or stroking pigs?

	Good						Bad
A	1	2	3	4	5	6	7
	Wise						Foolish
B	1	2	3	4	5	6	7

Appendix 2

The recording sheet that were used to record stockpersons working routines and behaviour towards the pigs once during one working day when he or she was performing daily routines in the selected housing section.

Working routines and interactions between stockperson and pig

Date: _____ Assessor: _____ Farm:_____

Stockperson: _____ Time in: _____ Time out: _____

			HAND			TOOL	FOOT	BODY	VOICE			
Pen	Number of pigs	Enters the pen (put X)	Scratch, stroke, pat pig gently	Laying hand on pig	Slapping, clapping/ pushing hard with hand on pig	Touch with tool on pigs' head/ body	Kick/ fasten with foot on pig	Control/ delimit pig by using own body	Talking in conversation tone	Talking/shouting with a loud voice	Whistle	High pitched vocalization by pig

Comments: _____

Appendix 3

The recording sheet was used to assess the expressive quality of pig behaviour and emotional state.

Qualitative Behaviour Assessment (QBA)

Date: _____ Observer: _____ Occasion: _____ Farm:_____

Time after caretaking: _____ Time start: _____ Time end: _____

Active	Min.	Max.
Relaxed	Min.	Max.
Fearful	Min.	Max.
Agitated	Min.	Max.
Calm	Min.	Max.
Content	Min.	Max.
Tense	Min.	Max.
Enjoying	Min.	Max.
Frustrated	Min.	Max.
Bored	Min.	Max.
Playful	Min.	Max.
Pos. occupied	Min.	Max.

Listless	Min.	Max.
Lively	Min.	Max.
Indifferent	Min.	Max.
Irritable	Min.	Max.
Aimless	Min.	Max.
Happy	Min.	Max.
Distressed	Min.	Max.
Sociable	Min.	Max.

Comments: _____

_____

_____

_____

Appendix 4

The recording sheet was used to measure pigs' fear of humans. Test 1 is a modified human-animal relationship test (HAR) and test 2 is a modified avoidance distance test.

Pigs reaction to a human stranger

Farm: _____ Date: _____

Assessor: _____

Pen	Time start	Number of pigs in pen	Test 1 Number of pigs panic response	Test 2 Number of pigs within 0.5 metres/ physical contact	Comments

Comments:

_____

_____

_____

_____